

# UK Patent Application GB 2 318 082 A

(43) Date of A Publication 15.04.1998

(21) Application No 9620977.0

(22) Date of Filing 08.10.1996

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(51) INT CL<sup>6</sup>

B29C 65/00

(52) UK CL (Edition P)

B5K K3AX1 K3F

(56) Documents Cited

GB 1376400 A

EP 0248412 A2

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(58) Field of Search

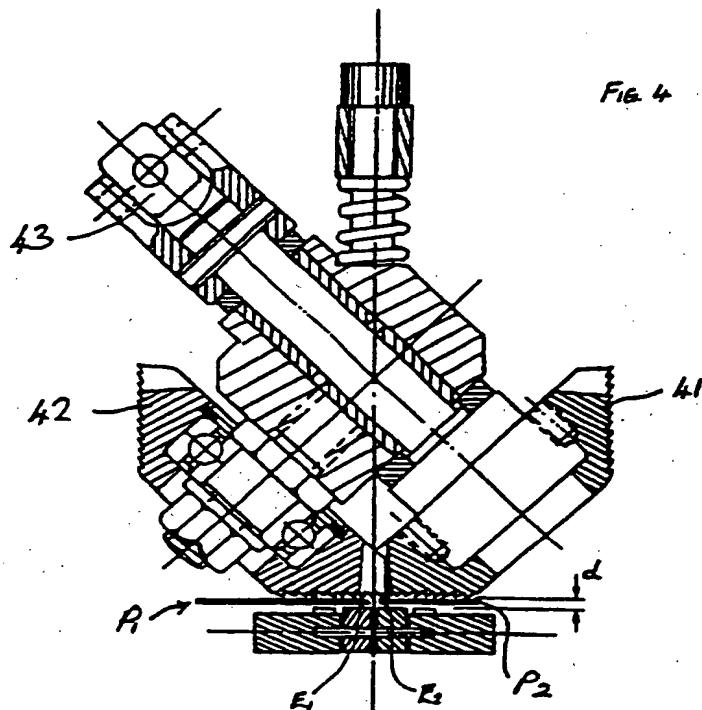
UK CL (Edition O) B5K

INT CL<sup>6</sup> B29C 65/00

Online: WPI

## (54) Method and apparatus for joining rubbery fabric

(57) A method of joining two sheets or plies of an uncured rubbery material by forming a butt-joint between adjacent edges  $E_1$ ,  $E_2$  comprises bringing the edges together under simultaneous pressure perpendicularly across the joint in the plane of the plies and perpendicularly to the plane of the plies. An apparatus for joining sheets in such a manner may comprise a pair of oppositely rotatable rollers 41, 42 each having a conical roll face for contacting the top surface of respective sheets to apply pressure in the plane of the sheets and co-operating cylindrical rollers to apply pressure perpendicularly to the plane of the sheets. The conical faced rollers may have concentric grooves on their gripping faces and intermeshing gears.



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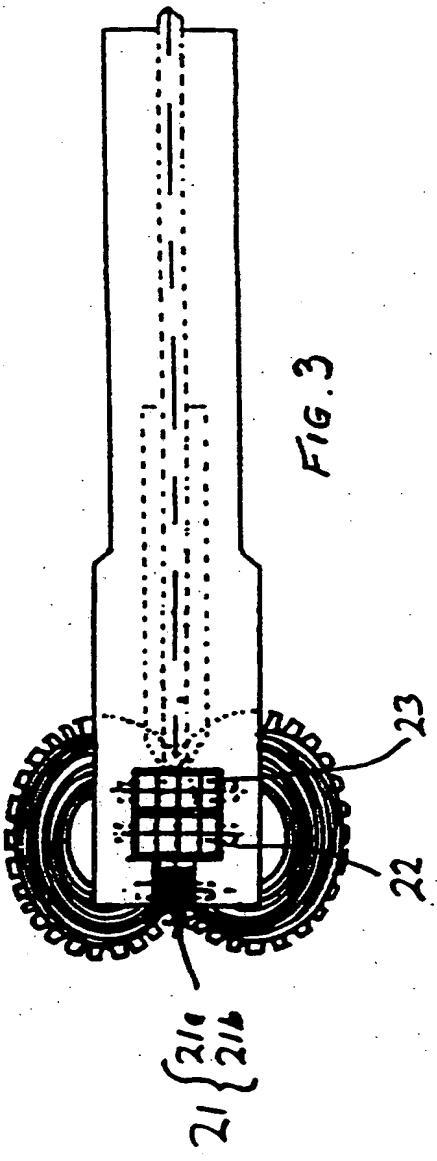
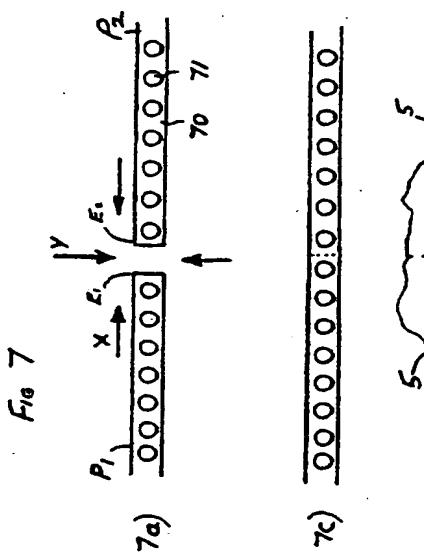
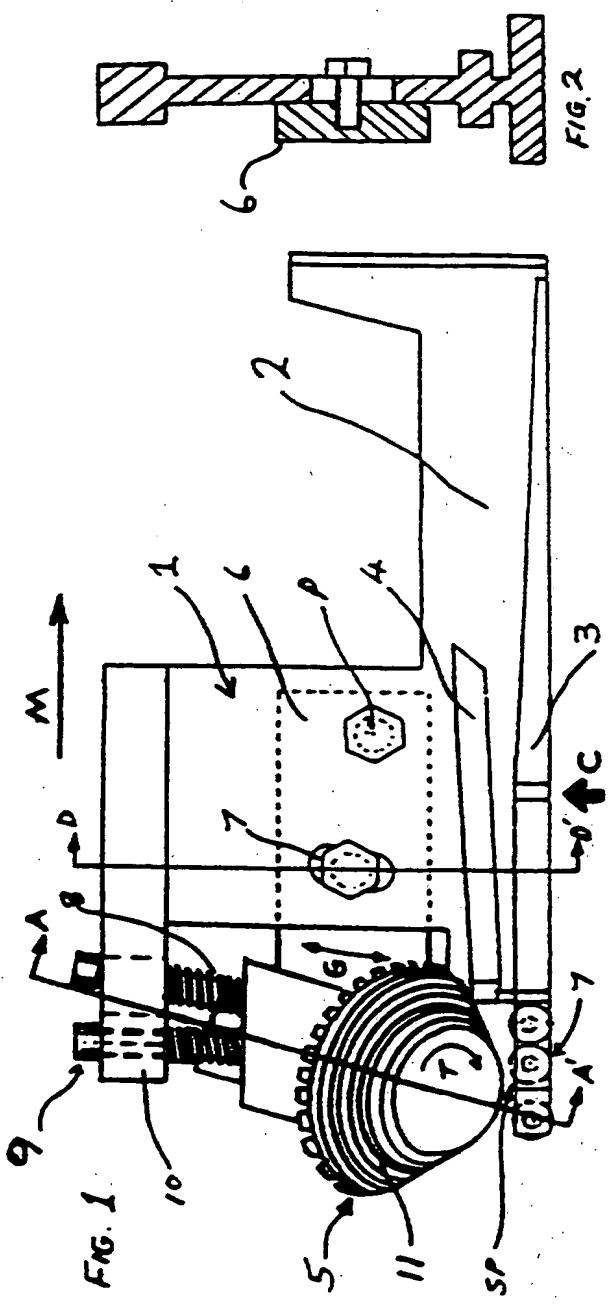


FIG. 4

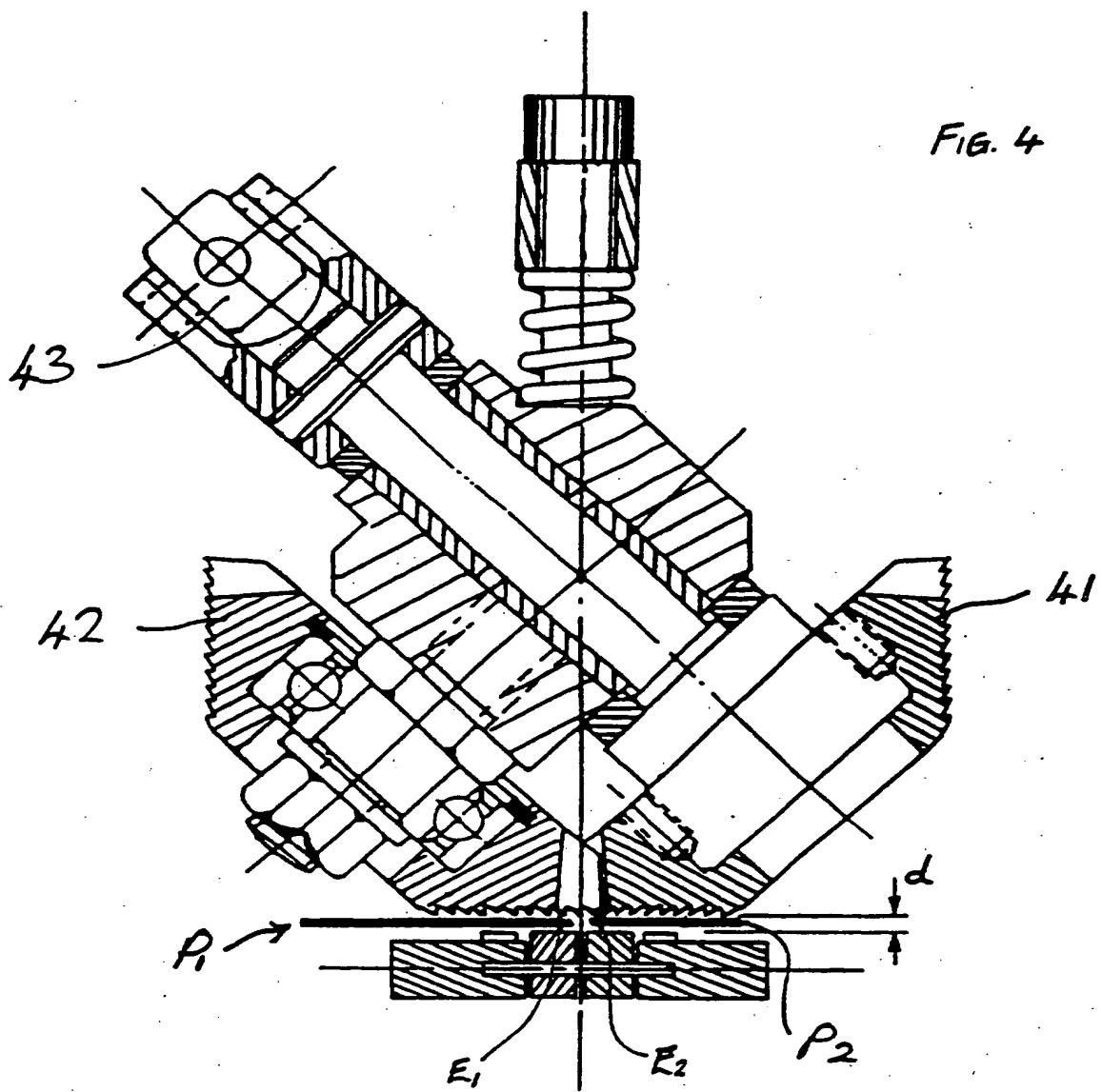


FIG. 5

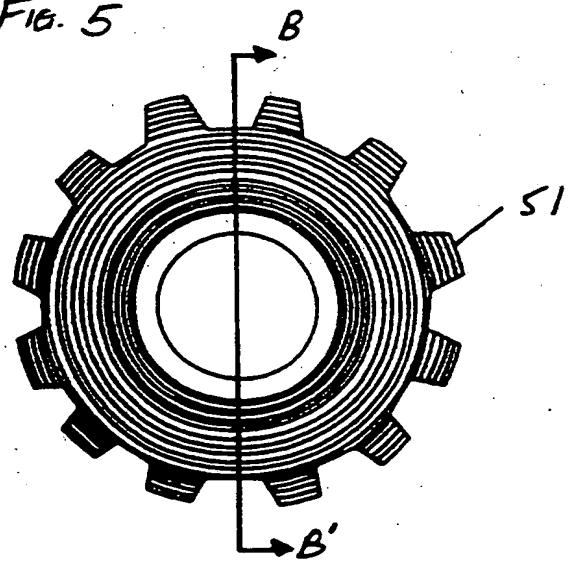
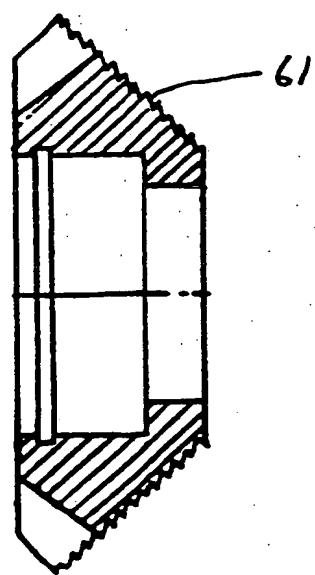


FIG. 6



METHOD AND TOOL FOR JOINING RUBBERED FABRIC

The present invention relates to a method and a tool for the joining of pieces or plies of rubbery materials such as might be used in the manufacture of reinforced elastomeric articles such as tyres or belting.

The manufacture of such articles often requires the joining of cord reinforced sheets or plies, of uncured rubber in an operation often referred to as 'stitching' performed using a 'ply stitcher'. Often the rubbery plies have reinforcing cords running in only one direction in the ply. Such rubber plies may be joined by overlapping their edges but in the case where the joint is parallel to the cord running direction this results in a local increase in the ply thickness in the region of the overlap joint. In such articles as tyres this can lead to an unacceptable disturbance in the uniformity of the product. Accordingly in tyre manufacture the joining of plies edge to edge in a butt-joint is very often preferred particularly where the reinforcing cords are steel.

Accordingly it is an object of the present invention to provide a method and a tool capable of joining rubbered fabric forming a butt-joint reliably and quickly.

According to one aspect of the invention a method of joining two sheets or plies of an uncured rubbery material by forming a butt-joint between adjacent edges in the same plane is characterised in that the edges are brought together under simultaneous pressures perpendicularly across the joint in the plane of the plies and perpendicularly to the plane of the plies.

Preferably the pressures are equal.

According to another aspect of the invention an apparatus for joining two sheets or plies of uncured rubbery material by forming a butt-joint between adjacent edges held in the same plane, characterised by means for applying pressure perpendicularly across the joint in a direction parallel to the plane of the plies and means for simultaneously applying pressure to the joint in a direction perpendicular to the plane of the plies.

Further aspects of the present invention will become apparent from the following description, by way of example only, of one embodiment and the following schematic drawings in which:-

Figure 1 is a schematic drawing showing a side elevation of a ply stitcher according to the present invention;

Figure 2 is a section view of the stitcher taken through plane D-D' of Figure 1;

Figure 3 is a bottom elevation of the stitcher of Figure 1 viewed in direction C;

Figure 4 is a sectional view of the stitcher of Figure 1 taken along the plane A-A';

Figure 5 is a schematic drawing of one of the two bevel gears of the stitcher of Figure 1; and

Figure 6 is a section view of the bevel gear of Figure 4 taken along plane B-B'; and

Figure 7 is a schematic diagram illustrating the dual perpendicular pressing action of the method and apparatus of the invention.

The ply stitcher shown in Figures 1-6 is a hand-operated tool designed to move in the direction of arrow M between two stationary adjacent ply edges in order to join them.

The stitcher comprises a main body 1 having an upright longitudinal guide plate 2, for guiding the tool between the ply edges E1 and E2, a tapered thickness bottom guide plate 3, on the bottom of the longitudinal guide plate 2, and slanting upper guide bars 4, one on each side of the longitudinal guide plate 2. The longitudinal guide plate 2, the bottom guide plate 3 and the upper guide bars 4 are arranged to guide and position the ply edges E1, E2 correctly for stitching at a stitching point SP at the rear of the tool.

Stitching occurs between surfaces on a pair of intermeshing bevel gears 5 positioned above the plies and a set of bottom rollers 7 below the ply.

The pair of bevel gears 5 are mounted on a mounting plate 6 which is pivotably fixed to the main body 1 at a point P and moveable in an arc in direction G towards and away from the bottom rollers 7 by means of the elongated slot 7 in the main body 6.

In the stitching operation the two pieces of ply material P1 and P2 are pressed between the pair of bevel gears and the bottom rollers. The gap d or 'nip' between the pair of bevel gears 5 and the set

of rollers 7 is adjustable by means of the spring tensioned setting screw 9 in order to accommodate different thicknesses of ply material. The gap d is set to be less than the thickness of the ply material. The pair of bevel gears 5 are movable away from the bottom rollers against the spring tension provided by the coil spring 8 held in compression against the upper limb 10 of the main body 1. The gap d is adjusted so as to exert a force or pressure across the thickness of the ply equal to the force or pressure exerted across the joint in the plane of the plies.

Details of the pair of grooved bevel gears 5 are shown in Figures 4-6. The pair of gears are identical in size and shape and have intermeshing gear teeth 51 on their outer peripheries. They comprise a driven gear 42 which is driven by a drive gear 41 which is itself driven via a universal type coupling 43 by any suitable means such as a pneumatic or electric motor. The gears are turned in a direction T such that the stitched ply material exits from the rear of the tool which is propelled forward in the direction M. Each of the bevel gears 5 is disposed such that at the bottom its conical face 11 is parallel to the bottom set of rollers.

The point of contact or meshing point of the bevel gears is at the stitching point above the bottom set of rollers 7. Accordingly at that point the conical faces of two gears effectively form a continuous rolling surface which is parallel to the bottom set of rollers 7.

The bottom set of rollers 7 comprises, in this embodiment, three rollers 21-23. The rearmost roller 21 is the narrowest roller and comprises two independent roll sections 21a and 21b. The remaining rollers 22 and 23 are equal size and comprise four independent roll sections. The rotational axis of each of the three rollers 21-23 is parallel with the continuous rolling surface formed at the meshing point of the two conical faces of the bevel gears.

Each of the bevel gears is provided on its conical face with a series of shallow concentric grooves 61 which serve to enhance grip the rubbery surface of the ply. Accordingly as the edge of each ply is brought by the respective bevel gear towards their meshing point the ply edges are forced together in the plane of the ply by the action of the bevel gears whilst simultaneously being nipped between the

bevel gears and the bottom rollers. This dual action in perpendicular directions ensures a well formed joint.

The dual pressing actions of the method and apparatus of the invention are illustrated in Figure 7 which shows diagrams of ply edges before and after stitching. Tyre cord fabric plies P1 and P2, each comprising steel cords 71 embedded in a matrix of rubber 70 are pressed together at edges E1 and E2. The conical-faced bevel gears 5 act in the plane of the plies P1 and P2 bringing the ply edges E1 and E2 together and pressing in direction X in Figures 7a and 7b whilst the action of the bevel gears 5 in conjunction with the bottom set of rollers 7 presses the plies simultaneously in the perpendicular direction Y. Accordingly, as shown in Figure 7c, the plies are joined without substantial disturbance to the overall thickness of the ply or spacing of the cords. Thus a joint is formed with minimum deterioration of uniformity of the ply.

Whilst the above-described apparatus has pressure applied in direction Y perpendicular to the plane of the plies by means of a cylindrical roller or set of cylindrical rollers, this pressure on the lower

surface of the ply may also be applied by a pair of conical-faced rollers similar or identical to the conical-shaped rollers contacting the upper ply surface.

The ply joining herein described has demonstrated the capability of forming butt-joints reliably and consistently in steel cord tyre fabric at speeds of up to 15m/min.

CLAIMS

1. A method of joining two sheets or plies (P1,P2) of an uncured rubbery material by forming a butt-joint between adjacent edges (E1,E2) in the same plane, characterised in that the edges (E1,E2) are brought together under simultaneous pressure perpendicularly across the joint in the plane of the plies and perpendicularly to the plane of the plies.
2. A method of joining two sheets or plies (P1,P2) according to claim 1, characterised in that the pressure across the joint in the plane of the plies and the pressure perpendicular to the plane of the plies are equal.
3. An apparatus for joining two sheets or plies (P1,P2) of uncured rubbery material by forming a butt-joint between adjacent edges (E1,E2) held in the same plane, characterised by means for applying pressure perpendicularly across the joint in a direction (X) parallel to the plane of the plies and means for simultaneously applying pressure to the joint in a direction (Y) perpendicular to the plane of the plies.
4. An apparatus according to claim 3, characterised in that the means for applying

pressure across the joint in a direction (X) parallel to the plane of the plies comprises a pair of oppositely rotatable rollers each having a conical roll-face for contacting the top surface of the respective plies, the rollers being disposed such that their conical faces meet to form in a straight line a continuous surface parallel to the ply surfaces and perpendicular to the direction of the ply edges.

5. An apparatus according to claim 4, characterised by the ply contacting conical faces of the rollers being provided with concentric grooves to enhance gripping of the ply surface.

6. An apparatus according to either of claims 4 or 5, characterised in that the rollers comprise two bevel gears (41,42), having intermeshing gear teeth formed on the edge of the conical face having the larger circumference.

7. An apparatus according to any of claims 4 to 6, characterised in that the means for applying pressure in a direction (Y) perpendicular to the plane of the plies comprises a bottom roller having a cylindrical roll surface for contacting the bottom surface of the plies, the axis of rotation of the bottom roller being parallel to the plane of the plies and perpendicular to the ply edges, the bottom

roller disposed so as to press the plies against the two conical faced rollers.

8. An apparatus according to any of claims 4 to 6, characterised in that the means for applying pressure in a perpendicular direction (Y) to the plane of the plies comprises a pair of oppositely rotatable rollers each having a conical roll-face for contacting the bottom surface of the respective plies, the rollers being disposed such that their conical faces meet to form in a straight line a continuous surface parallel to the ply surfaces and perpendicular to the direction of the edges.

9. An apparatus for joining two sheets or plies (P1,P2) of uncured rubbery material substantially as described herein and shown in Figures 1 to 7.



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Application No: GB 9620977.0  
Claims searched: 1-9

Examiner: Michael Richardson  
Date of search: 23 December 1996

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B5K

Int Cl (Ed.6): B29C 65/00

Other: Online: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1376400 (CONTINENTAL) See page 2 lines 42-116	1, 3
X	EP 0248412 A2 (PIRELLI) See page 21 lines 9-19 and page 17 lines 23-32	1, 3, 4, 6, 8
X	US 5221409 (HART) See Figures 3-5	1, 3-8
X	US 4478672 (PRECHT) See column 7 lines 7-55	1-6
X	US 4231836 (LJUNQVIST) See Figure 8 and column 2 lines 40-59	1, 3-5, 8
X	US 3909341 (MOSCOWITA) See Figure 2	1, 3, 4, 8

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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